Selenium in Sediments

270 soil cores representing 15 Imperial Valley fields

Median Se conc. = 0.2 ppm (min = 0.1 max = 1.3 ppm)

Bottom sediment - 48 surface drains in Imperial Valley

Median Se conc. = **0.5** ppm (min = 0.1 max = 1.7 ppm)

Se in bottom sediment of surface drains excellent correlation with % material finer than 0.062mm (sand/silt break)

Salton Sea bottom sediment – 11 sites

Median Se conc. = **2.7** ppm (min = 0.58 max = 11 ppm)

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Selenium Changes in Alamo River Delta and Salton Sea

Selenium speciation – special sample June 1989

River side of interface had total Se = 6.35 ug/L

2.56 ug/L in +4 selenite state

3.79 ug/L in +6 selenate state

At interface had total Se 2.4 ug/L (method reporting limit)

1.79 ug/L in +4 selenite state

0.2 ug/L in +6 selenate state

Salton Sea water = 1 ug/L, none in +6 state

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Salton Sea Bottom Sediment Sampling Sites

Bottom sediment samples collected from 11 sites during July 20-22, 1998

Samples collected using modified Ekman dredge

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Table 1. Speciation of Se (µg/L) in water.

Summer 2003, UC Riverside

Samples	Se (IV)	Se (VI)	Organic Se	Total Se
White river 2-1	0.685	2.419	0.040	3.144
White river 2-2	0.625	2.318	0.213	3.156
New river 2-1	1.350	2.034	0.545	3.929
New river 2-2	1.330	2.078	0.396	3.804
Alamo river 2-1	1.075	3.932	0.202	5.209
Alamo river 2-2	1.135	3.864	0.349	5.348
SS-S1 2-1	0.410	0.481	0.925	1.817
SS-S1 2-2	0.560	0.268	0.843	1.671
SS-S2 2-1	0.410	0.335	1.013	1.758
SS-S2 2-2	0.445	0.169	1.320	1.934
SS-S3 2-1	0.440	0.375	0.912	1.728
SS-S3 2-2	0.750	0.330	0.563	1.643
SS-B1 2-1	0.365	0.287	0.910	1.562
SS-B1 2-2	0.450	0.311	0.698	1.459
SS-B2 2-1	0.590	0.302	0.608	1.500
SS-B2 2-2	0.515	0.210	0.778	1.503
SS-B3 2-1	0.455	1.104	0.534	2.093
SS-B3 2-2	0.570	0.839	0.542	1.952

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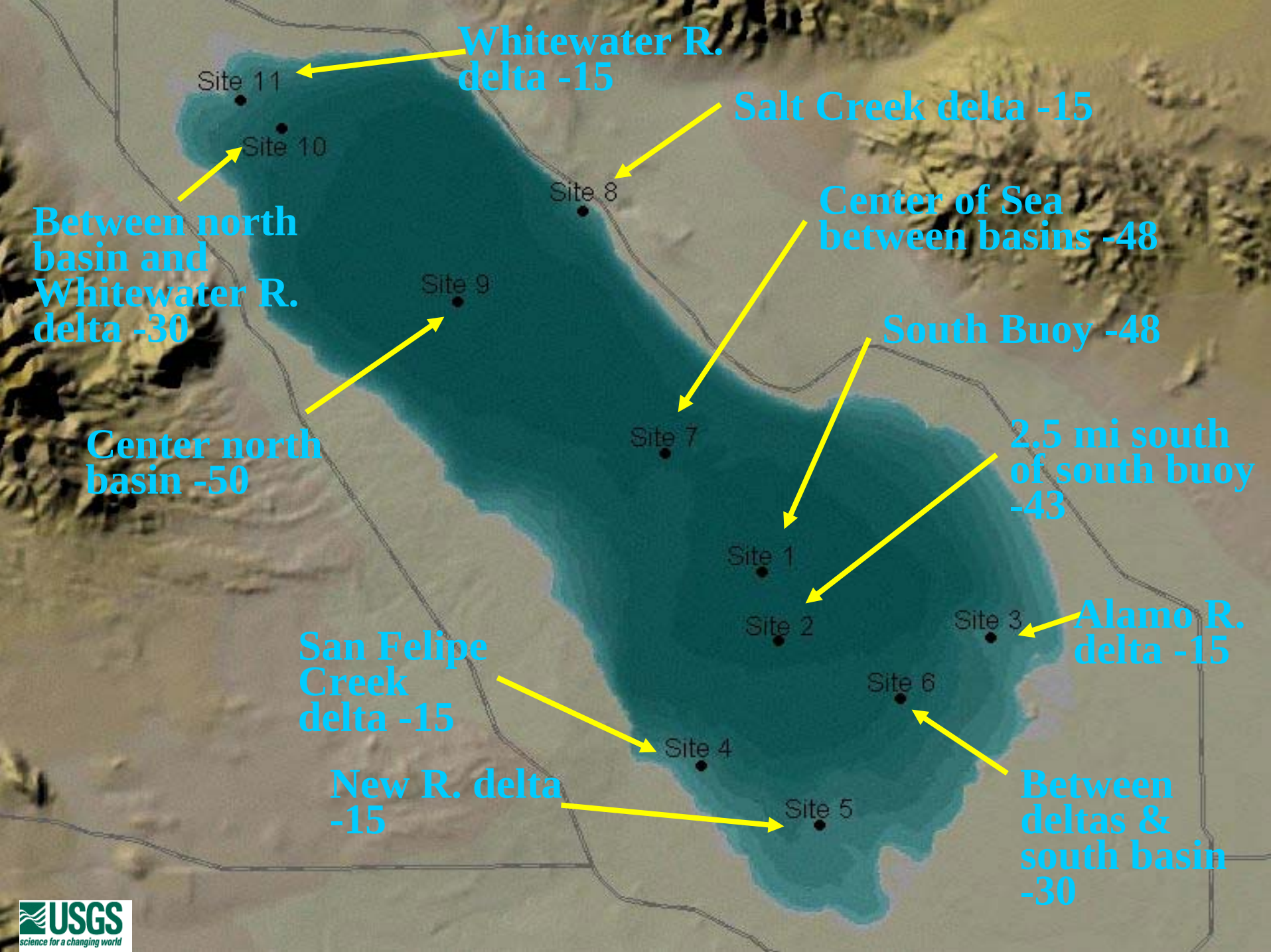
Whitewater R. delta -15
Site 11
Site 10
Salt Creek delta -15
Site 8
Between north basin and Whitewater R. delta -30
Center of Sea between basins -48
Site 9
South Buoy -48
Center north basin -50
Site 7
2.5 mi south of south buoy -43
Site 1
Site 2
Site 3
Alamo R. delta -15
San Felipe Creek delta -15
Site 6
Site 4
New R. delta -15
Site 5
Between deltas & south basin -30
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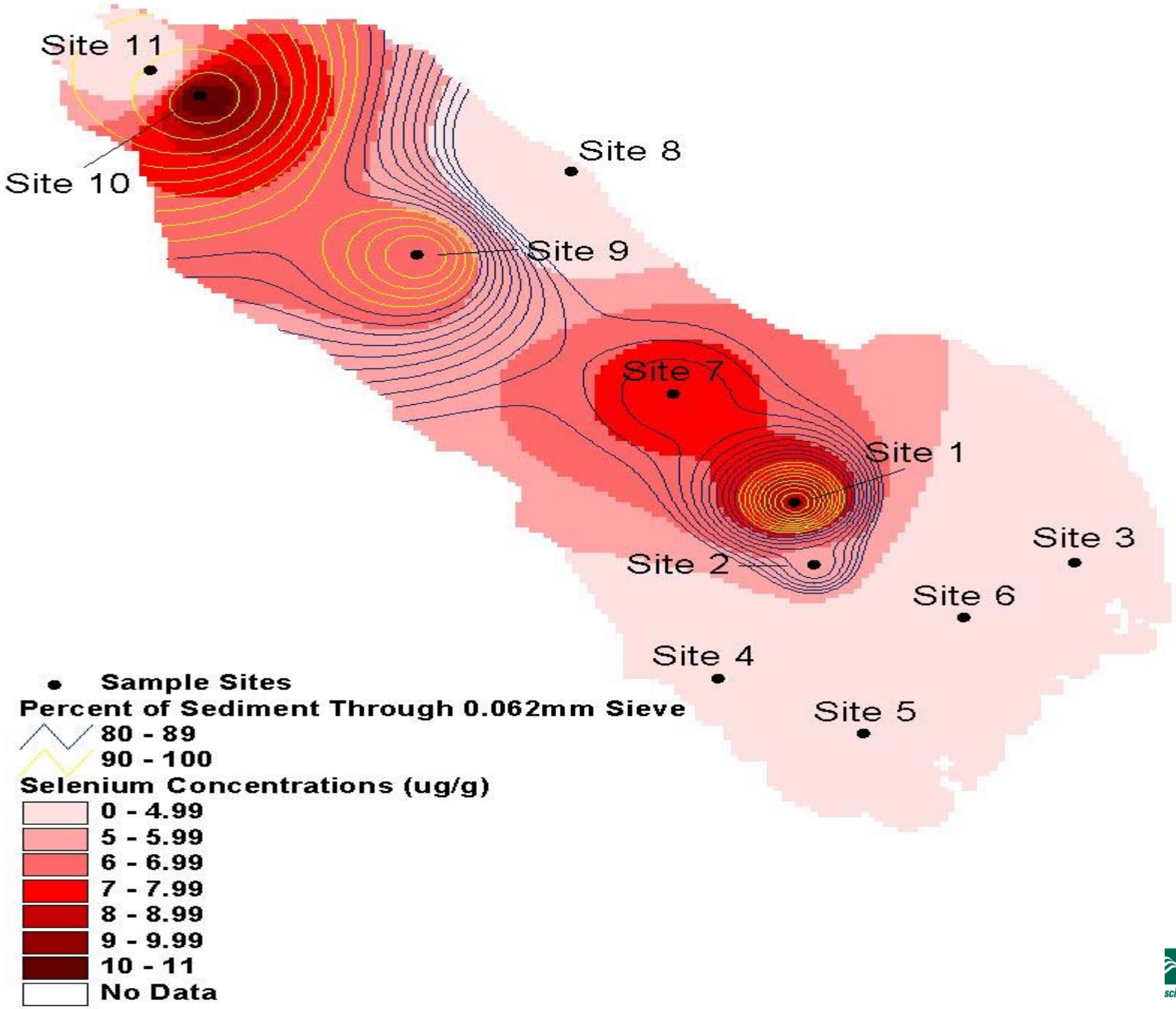

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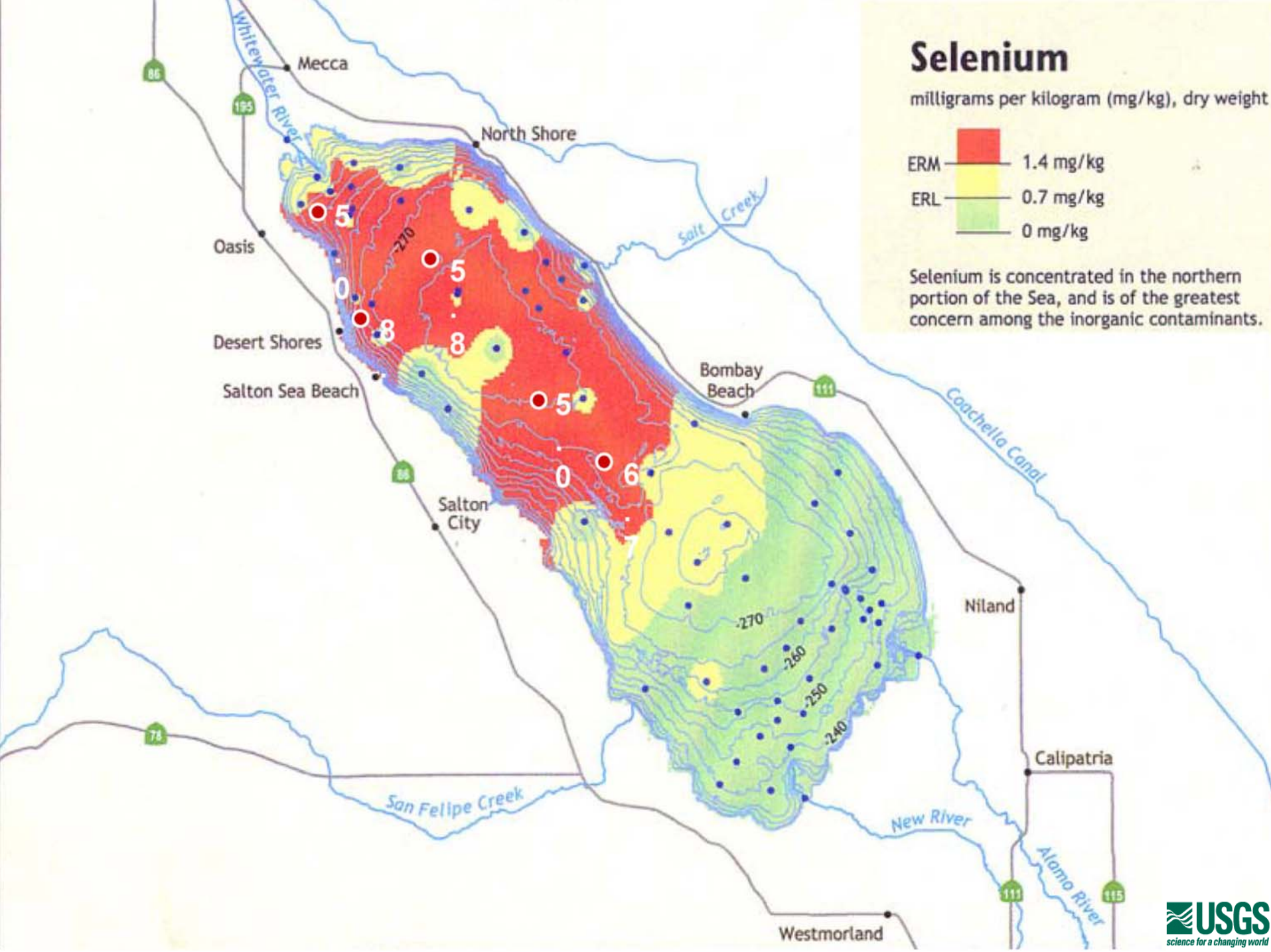
Selenium
milligrams per kilogram (mg/kg), dry weight
ERM
1.4 mg/kg
ERL
0.7 mg/kg
0 mg/kg
Selenium is concentrated in the northern portion of the Sea, and is of the greatest concern among the inorganic contaminants.
Mecca
North Shore
Oasis
Desert Shores
Salton Sea Beach
Bombay Beach
Salton City
Niland
Calipatria
Westmorland
Whitewater River
Salt Creek
Coachella Canal
San Felipe Creek
New River
Alamo River
-270
-260
-250
-240
5
0
8
5
8
5
0
6
7
86
195
111
78
115

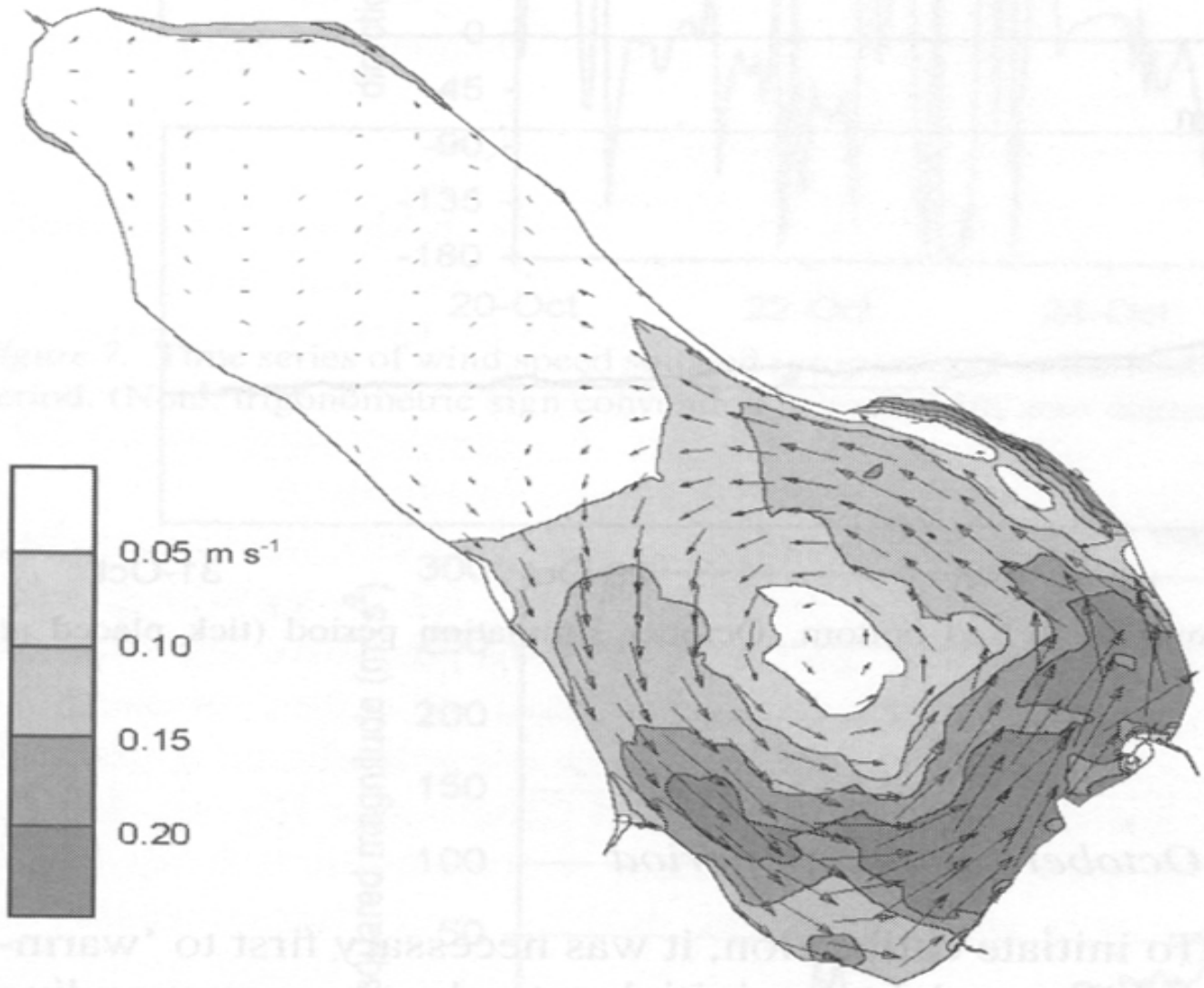

Figure 11. Circulations at mid-depth, October simulation period (October 24 at 9 p.m.).


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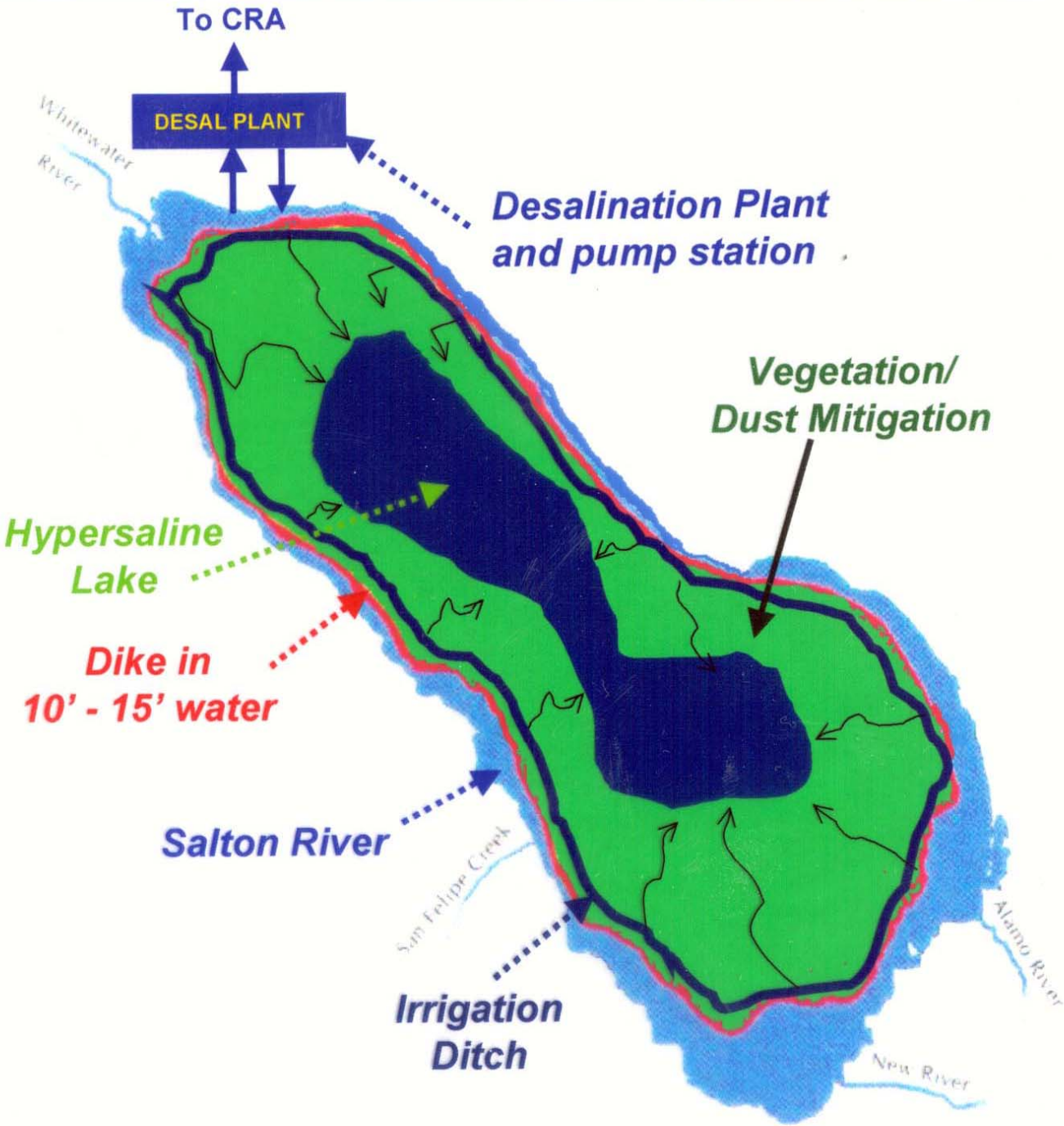
Sand Bars
Johnson Island
West Whitewater Rookery
76th Avenue Powerline
Oasis
81st Avenue Snags
North Shore
Salton Sea State Park Boat Landing
Corvina Estates Boat Launch
Desert Shores Boat Launch
Desert Shores
Salton Sea Beach Marina
Salton Sea Beach
Johnsons Landing
Salton City
Bombay Beach Rookery
Bombay Beach
Bombay Marina
Mallard Road Rookery
Ibis Road Rookery
South Ibis Road Blinds
Wister Blinds
Niland
Sonny Bono Salton Sea National Wildlife Refuge (SBSSNWR)
Red Hill Marina
Mullet Island
Old Alamo River Channel
Red Hill Snag Field
Impoundment Area
Obsidian Butte Island
Test Base Pier
San Felipe Rookery
Lack/Lindsey Rookery
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
Ramer Lake Nor
111
86
78
-240 Dike Elevation Option
Additional Water Loss Through
Use of Treatment Wetlands

The Salton River Concept



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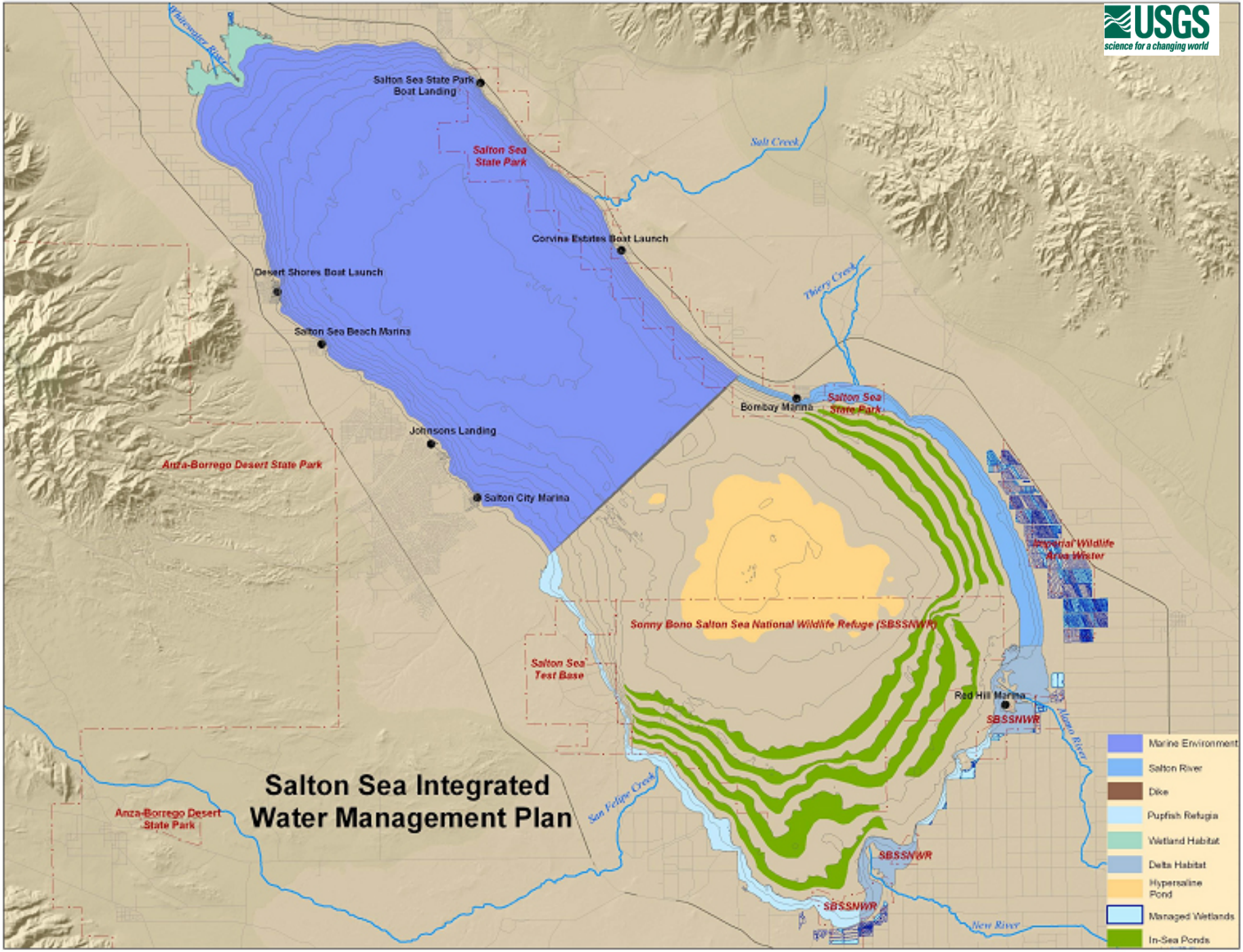
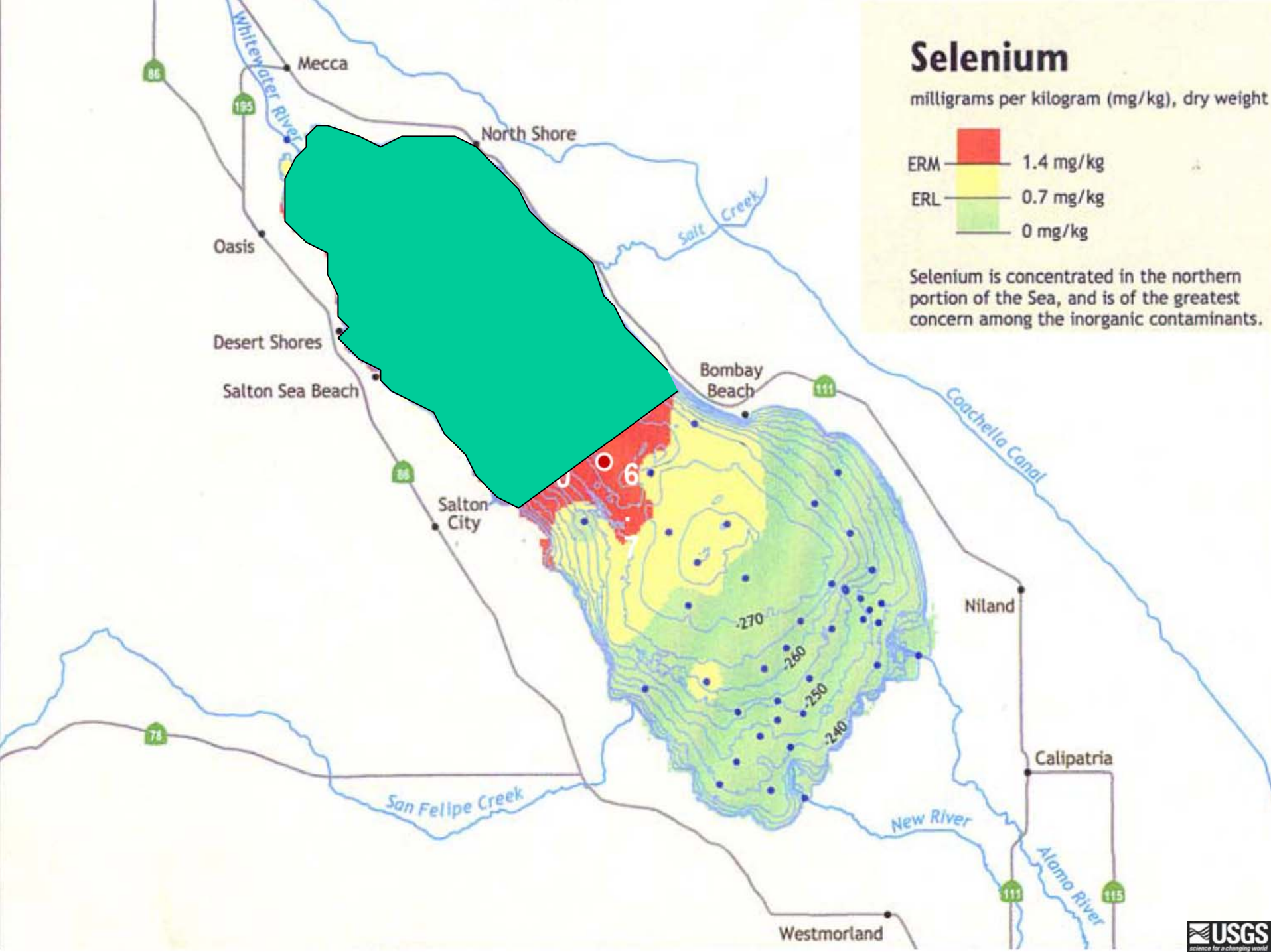

USGS
science for a changing world
Whitewater River
Salton Sea State Park Boat Landing
Salton Sea State Park
Salt Creek
Corvina Estates Boat Launch
Desert Shores Boat Launch
Thiers Creek
Salton Sea Beach Marina
Bombay Marina
Salton Sea State Park
Johnsons Landing
Anza-Borrego Desert State Park
Salton City Marina
Imperial Wildlife Area Water
Sonny Bono Salton Sea National Wildlife Refuge (SBSSNWR)
Salton Sea Test Base
Red Hill Marina
SBSSNWR
Alamo River
Salton Sea Integrated Water Management Plan
Anza-Borrego Desert State Park
San Felipe Creek
SBSSNWR
SBSSNWR
New River
Marine Environment
Salton River
Dike
Pupfish Refugia
Wetland Habitat
Delta Habitat
Hypersaline Pond
Managed Wetlands
In-Sea Ponds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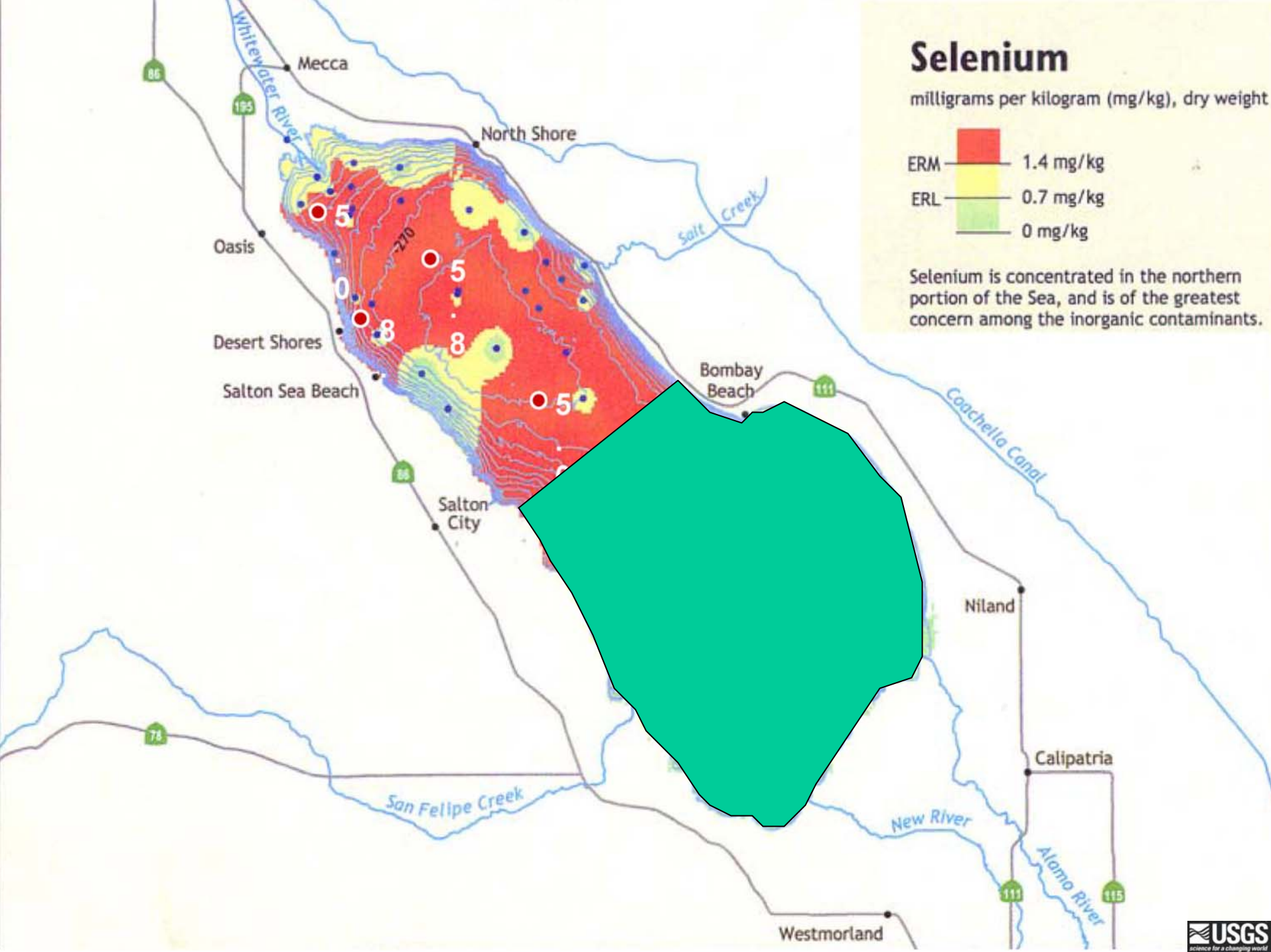
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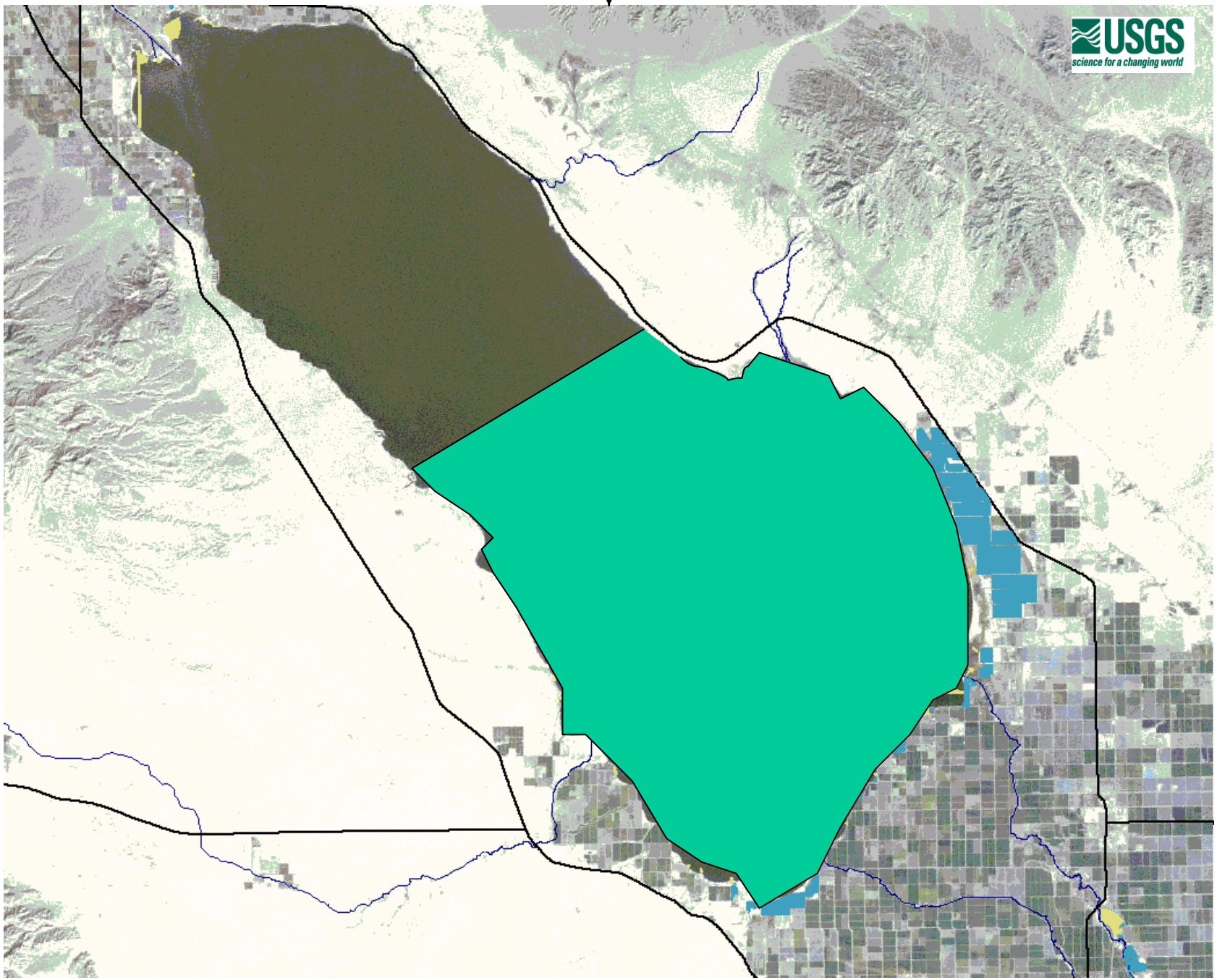
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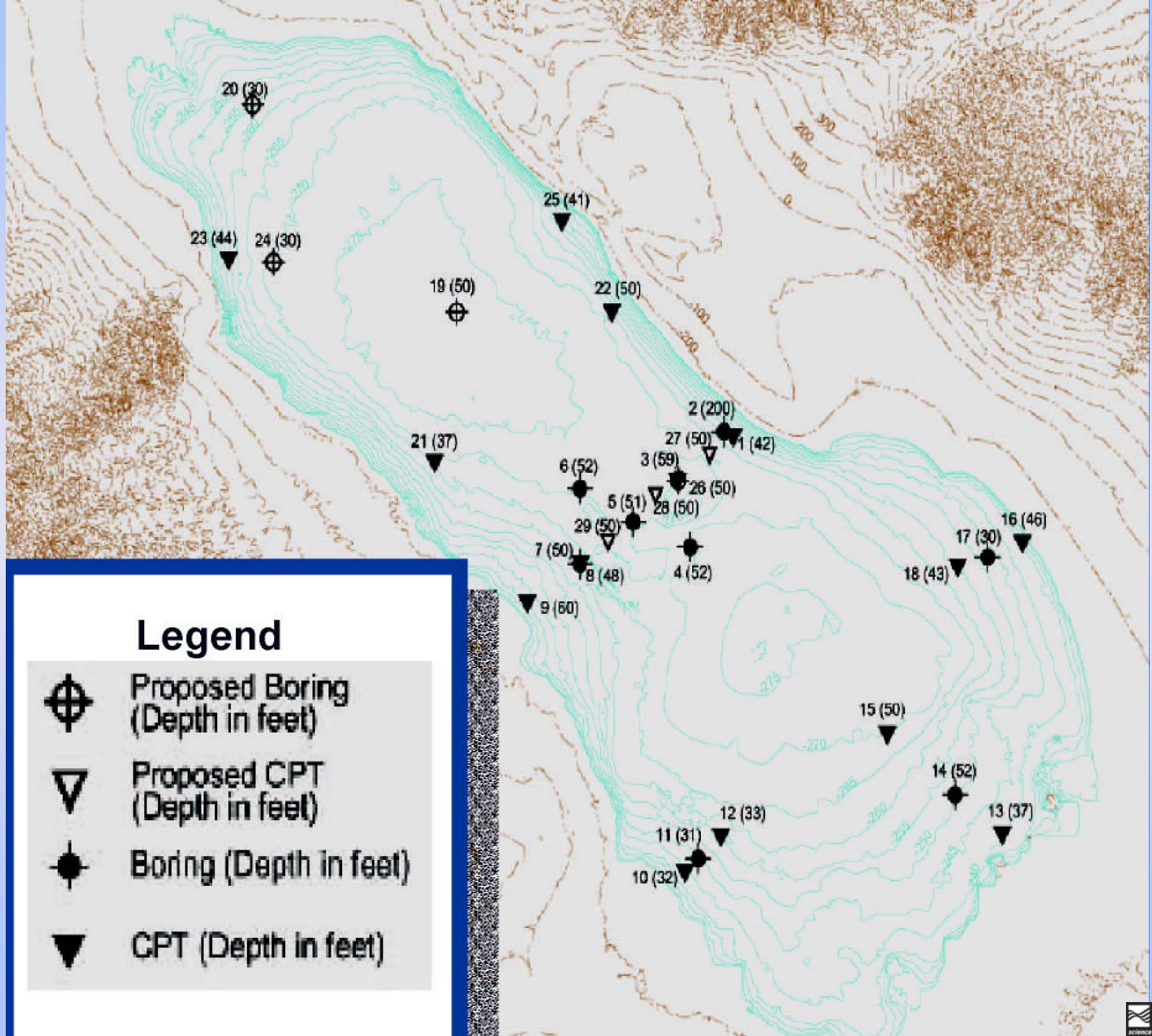
20 (30)
25 (41)
23 (44)
24 (30)
19 (50)
22 (50)
2 (200)
27 (50)
1 (42)
21 (37)
3 (59)
6 (52)
26 (50)
5 (51)
28 (50)
29 (50)
16 (46)
17 (30)
7 (50)
18 (43)
8 (48)
4 (52)
9 (60)
15 (50)
14 (52)
12 (33)
13 (37)
11 (31)
10 (32)
Legend
Proposed Boring (Depth in feet)
Proposed CPT (Depth in feet)
Boring (Depth in feet)
CPT (Depth in feet)

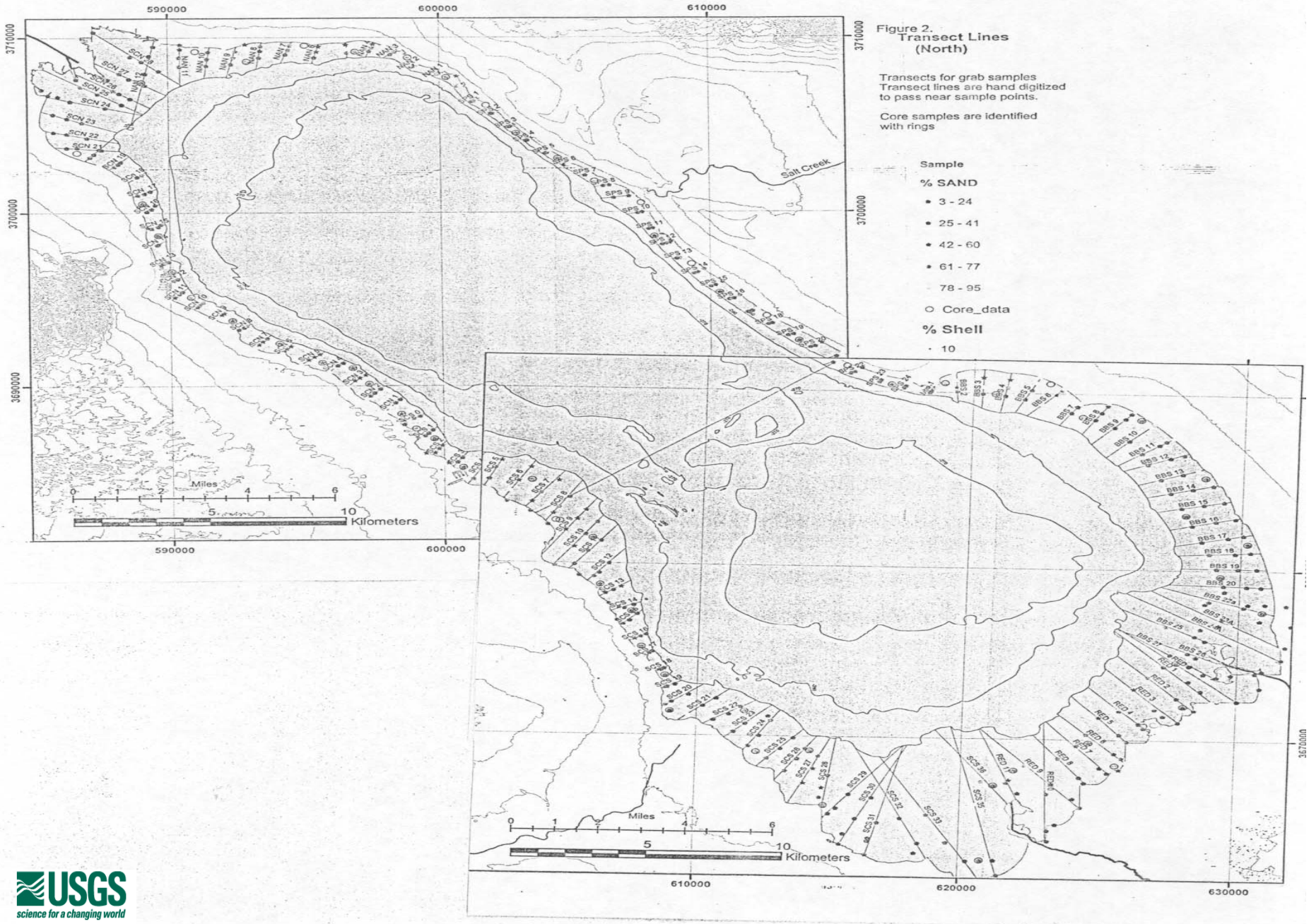

Figure 2.
Transect Lines
(North)

Transects for grab samples
Transect lines are hand digitized
to pass near sample points.

Core samples are identified
with rings

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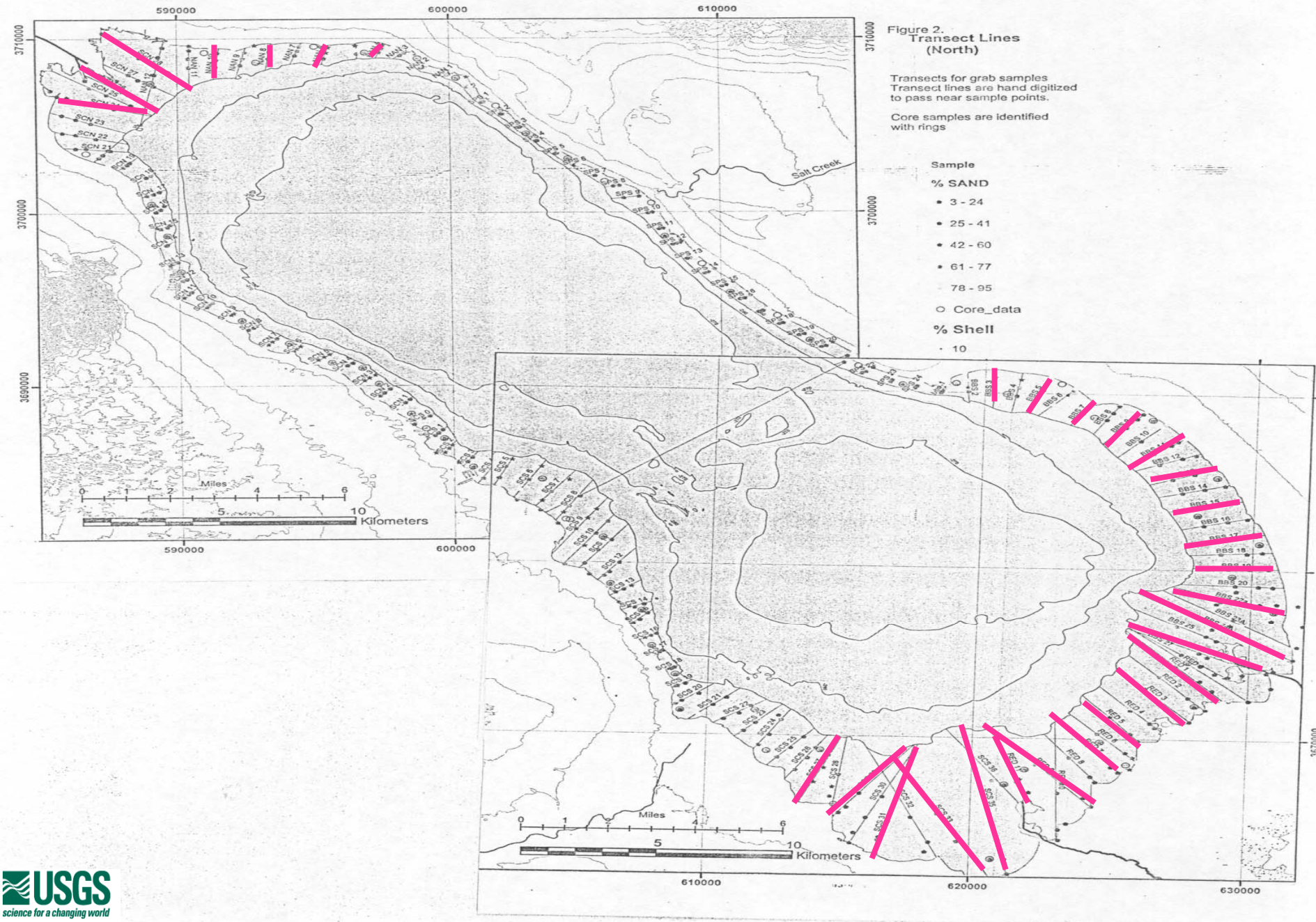

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Transect Lines
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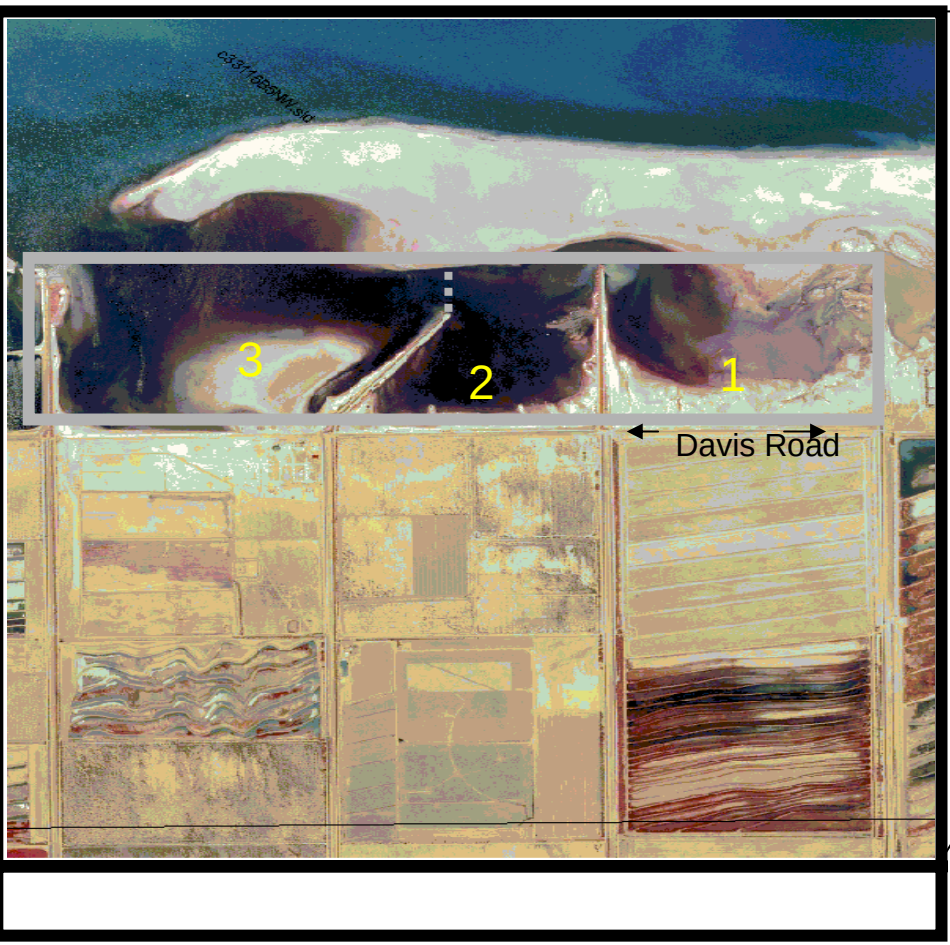
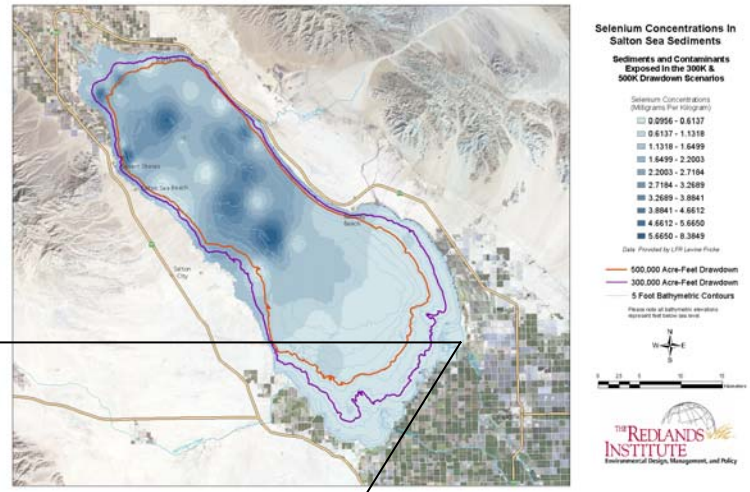
Current Research

- Kent Sea Tech has also done some work on water treatment using rapid growth algae followed by tilapia to remove nutrients on Whitewater River. It was noted that this system cannot work in winter when water temperatures become too low for tilapia to survive. Has potential for selenium removal through algae harvesting
- Other work that has been contracted includes sediment characterization at 5-foot depth intervals down to 25 ft deep from last year's (2003) shoreline (dataset is strongest to 15 ft. depth). There are about 1000 samples from this study that are archived USGS has arranged for selenium analyses for about 100 samples and is seeking aid for an additional 100 samples. Expect results in 3 to 6 month time frame.
- Report by Chris Holdren/USBR in Denver that looked at water, sediment along depth transects around the Sea. This effort is continuing quarterly
- Deep core samples were done for geotechnical evaluations in proposed dike locations. USGS also wants to get some of these archived core samples analyzed for selenium.
- Ongoing project by Chuck Henny/USGS from Corvallis, OR being conducted to look at contaminant levels in bird eggs (great egret, black-crowned night-heron, and black-necked stilts [N = about 12 per species] ; there were not enough avocet eggs). GEs and BCNHs from north end only; stilts from north and south. The samples were sent to Canadian lab about 2-3 weeks ago.

Current research cont'd

- Chris Amrhein/UC Riverside has also looked at chemical flocculent (polyacrilimides/alum) on farm and in drains – in conjunction with Kent Sea Tech project.. Water treatments were primarily intended to address TMDL issues but also have some data on selenium and methods have potential for reducing selenium inputs to the sea along with nutrients
- Also in future, the SSA is looking at shallow water habitat ecological issues. They will complete a project with USBR funding to revitalize existing dikes to create shallow water habitats (most about 1 inch deep) with water conditions similar to effluent from desalination plant (using blended fresh and Salton Sea water). Anticipated date for water floodup is January 2005 and they will give the system about 6 months to stabilize before sampling begins (other than pre-project baseline sampling that will occur





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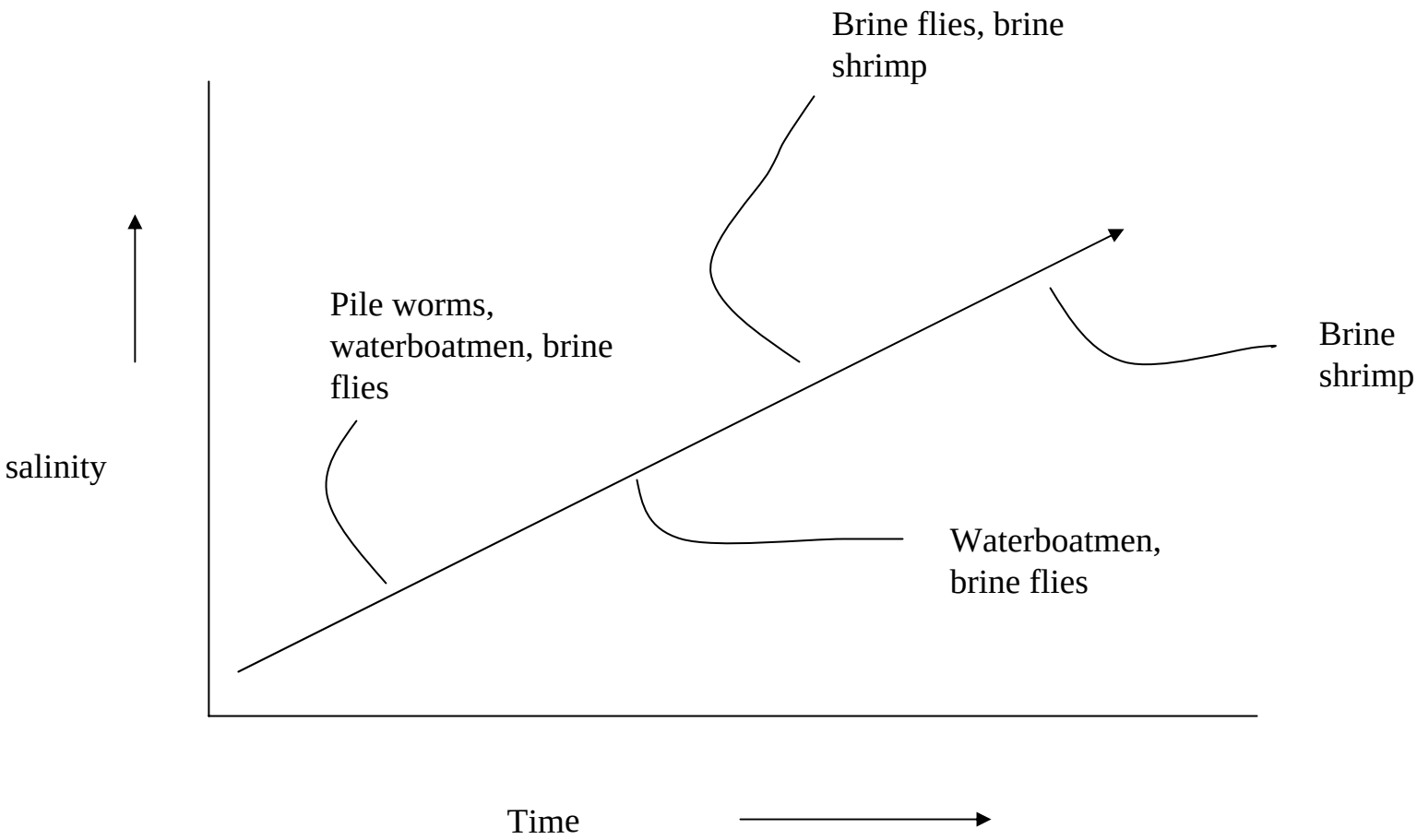
Considerations

- North sea vs south sea? Trade off of how sea treats selenium moving sequestration from north to south
- Freshwater affects selenium differently than salt water
- Nutrients affect selenium through algal growth and uptake
- Plant life affects selenium uptake and biotic availability
- Sulfates affect selenium
- Water depth affects selenium through redox potential
- Water depth affects selenium through invertebrate production and food availability to birds
- TMDL affects nutrients which affects algal growth which affects se uptake
- Any alternative implemented using Colorado River water as the supply will have to accommodate concerns over selenium, including any mitigation considered outside of the Salton Sea Ecosystem.



No action alternative and any alternatives with brine pools, includes increasing salinity, loss of fish and transition to macroinvertebrate, microbial system, concurrent transition to loss of fish eating birds and increase in insectivorous birds. Salton Sea increasing importance to eared grebes, ruddy ducks, shorebirds, and system is probably more efficient at selenium transfer at that point.